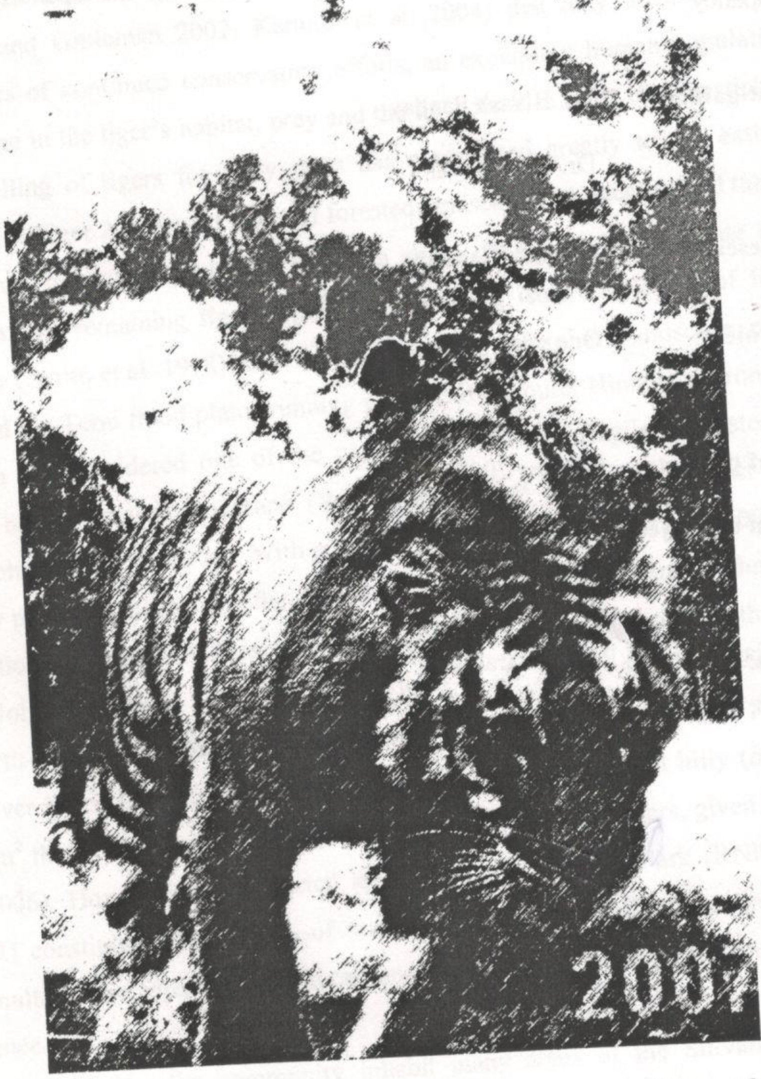
Project - 5

Project proposal for a grant

"Response of tiger population to habitat, wild ungulate prey and human disturbance in Rajaji National Park, Uttarakhand, India: Assessing the spatio-temporal variations in occupancy"



Researcher

Abishek Harihar, JRF

Principal Investigators

Dr. Bivash Pandav

Dr. S. P. Goyal

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भारतीय वन्यजीव संस्थान
Wildlife Institute of India

1. **Title of the project:** "Response of tiger population to habitat, wild ungulate prey and hum disturbance in Rajaji National Park, Uttarakhand, India: Assessing the spatio-tempo variations in occupancy"

2. **Name of the investigators:** Dr. Bivash Pandav

   Dr. S. P. Goyal

   Researcher: Abishek Harihar

3. **Duration of the project:** One year

4. **Date of initiation of project:** October 2007

   Date of completion of project: September 2008

5. **Study area:** Rajaji National Park, Uttarakhand.

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Response of tiger population to habitat, wild ungulate prey and human disturbance in Rajaji National Park, Uttarakhand, India: Assessing the spatio-temporal variations in occupancy

Introduction

Tigers (*Panthera tigris*) are critically endangered large carnivores, whose extinction risk is compounded by their need for large disturbance free ranging areas and their dependence on prey species (Carbone and Gittleman 2002, Karanth et al. 2004) that may themselves be threatened. Despite thirty years of continued conservation efforts, an expanding human population has caused considerable decline in the tiger's habitat, prey and the tiger itself in India (Seidensticker et al. 1999). Though illegal killing of tigers for body parts has contributed greatly to the extinction of local populations (Project Tiger 2005), vast tracts of forested landscape that once housed the tiger have now been lost to human habitation. This has caused a sharp decline in the ungulate populations and confined many of the remaining tiger populations to small, isolated patches of forests across its distribution range (Smith et al. 1998). One such landscape, the Terai arc landscape, encompassing the Shivalik hills and the Terai flood plains running parallel to the outer Himalayas from Jammu through Nepal to Assam are considered one of the most threatened and fragile ecosystems in the Indian subcontinent. This productive landscape (Wikramanayake et al. 2004) is most prone to human disturbances (Johnsingh et al. 2004). With a human population density of over 500 people km^{-2}, this region is highly populous, surpassing the national average of 300 people km^{-2} (Johnsingh et al. 2004). Viable populations of tigers in this landscape exist only in small patches that have very low connectivity (Johnsingh et al. 2004, Wikramanayake et al. 2004). According to Johnsingh et al., (2004) the north-western portion of this landscape stretching from the Yamuna River in the west to the Sharda River bordering India and Nepal in the east, this fragmented hilly (*bhabar*) tract covers nearly 6500km^2 that could potentially support a minimum 150 adult tigers, given adequate protection (Johnsingh 2006). However, the protected areas of Rajaji National Park (RNP) and Corbett tiger reserve (CTR) constitute of only 30% of this landscape. While the surrounding landscape matrix consists of multiple use forests, agricultural land and human habitation thus being less suitable for tiger persistence.

Gujjars, a pastoralist community inhabit many areas of the Shivaliks. With their large holdings of Buffaloes (*Bubalis bubalis*), intensive grazing, lopping and firewood extraction, a lack of sustainable regeneration and proliferation in weeds (Edgaonkar 1995) had led to habitat degradation. Until recently they inhabited many parts of RNP. Following a relocation program initiated by the Uttarakhand Forest Department in 2003 much of the occupied areas within RNP were made free of *gujjar* settlements and signs of recovery with respect to utilization of the area by wildlife were noticed from studies conducted in the Chilla range (Harihar 2005; Kurien 2005; Harihar et al., 2006) of RNP.

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While the conservation efforts of the government of Uttarakhand continue to give a glimmer of hope for the long-term persistence of tigers (Johnsingh et al., 2004; Harihar 2005; Kurien 2005; Harihar et al., 2006; Johnsingh 2006), we feel that critical quantitative information regarding the status of prey and predator populations should be available to managers so as to ensure the recovery and long-term persistence of tigers within this landscape. Therefore, an in depth study on the responses of tigers to habitat, wild ungulate prey and human disturbances was initiated following the relocation of *Gujjar* settlements from many parts of the RNP.

What has been achieved so far

Following the range wise relocation programme initiated by the Uttarakhand Forest Department in 2003, Chilla range of RNP has provided us an opportunity to document changes in prey-predator populations following relocation of human settlements (Pandav et al. 2004; Harihar 2005; Kurien 2005; Harihar et al. 2006). The area with its high-density prey population and breeding tigers has the potential to support a higher density of tigers (Harihar 2005; Harihar et al. 2006). As high prey biomass correlates to higher chances of persistence of predator populations (Carbone and Gittleman 2002), such areas will have to be protected so as to ensure the long-term survival of medium to large carnivores. Kurien (2005) showed that prey distribution was influenced by anthropogenic pressures, while Harihar (2005) and Harihar et al., (2006) show that the Chilla range of RNP harbour high prey densities and predict higher tiger densities following the minimising of anthropogenic influence. However, Harihar et al. (2006) documented variations in prey and predator populations across seasons and established a monitoring protocol to assess population dynamics of prey and predators across four seasons (October 2006; Post Monsoon, January 2007; Winter, April 2007; Summer and July 2007; Monsoon). The results of the study (Harihar, A., Pandav, B. and Goyal, S. P. Unpublished data, WII) showed that wild prey densities varied across the four sampled seasons, from ~35 individuals per km^2 (monsoon) to ~80 individuals per km^2 (summer) within Chilla range of RNP, indicating a congregation of prey species into the valley during summers probably in response to the decreasing availability of water in the hills. Though adult tiger densities did not vary significantly across the seasons (~3 individuals per 100km^2), individual turnover was noticed with only two individual tigers being common to three sampled seasons (owing to logistic constraints systematic sampling to estimate tiger densities was not possible during the monsoon of 2007 therefore restricting the sampling to post monsoon, winter and summer). It was also noticed that capture probabilities varied across the three seasons, indicating increased tiger movement during winters within the Chilla range of RNP. These results have thus made it imperative for us to understand the spatio-temporal occupancy patterns of both tigers and wild ungulate prey.

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Project Objectives

Based on the results presented in Harihar et al., (2006) and Harihar, A., Pandav, B. and Goyal, S. P. (Unpublished data, WII) it is evident that the population of prey and tigers using the Chilla range of RNP seem to be increasingly dependent on the surrounding forests thus making it imperative to understand the spatial dynamics of these populations and continually monitor the abundance of prey and tigers. During this study it is proposed that sampling will be carried out across the seasons (October 2007; Post Monsoon, January 2008; Winter, April 2008; Summer and July 2008; Monsoon) with the following objectives

1. Estimate the occupancy rates of principal prey species in RNP using pellet encounters based on a hierarchical sampling design.
2. Assess the occurrence patterns of tigers and leopards in RNP using sign surveys along dry streambeds.
3. Estimate the principal wild prey (Sambar, Chital, Nilgai and Wild Pig) densities using line transects in conjunction with distance sampling methods
4. Estimate the density of tigers using photographic capture-recapture sampling and
5. Assess the food habits of tigers and leopards from field collected scats.

Methods

Estimating the occupancy rates of principal prey species in RNP

In order to estimate the occupancy of wild ungulate prey species in RNP the entire study area would first be gridded into 2km x 2km grids. An approximate 30% of the grids with a minimum 3 repeats would be sampled within the available time frame. Within each of the grids a transect of 2km would be laid and nested sampling plots at an intervals of 200m would be used to sample for vegetation and animal signs. At each of the sampling points GPS location is taken and a 10m radius circular plot would be used assess the tree species composition, tree density and canopy cover, a nested 5m radius circular plot would be used to assess the shrub species composition, percent shrub cover, average shrub height and pellet group count while five 1m radius plots would be sampled within the larger 10m radius plot for grass and herb species composition, average vegetation height and percent cover of grass and herbs, bare ground and rock. In order to model for wild ungulate occupancy, repeat counts of ungulate pellet counts would be used under the occupancy models in program PRESENCE2.0 (Hines 2006) wherein percent shrub cover and percent cover of grass and herbs would be used to model detection probabilities (*p*) while other vegetation (stated above), Geographic Information Systems and Remote Sense variable such as elevation, slope and NDVI would be used as site covariates. Ecological Niche Factor Analysis techniques would also be employed using Biomapper 4.0 beta (Hirzel et al. 2002).

Assess the occurrence patterns of tigers and leopards in RNP

Streambeds or raus will be chosen as the line of walk for tiger sign surveys. Indirect evidences in the form of pugmark, scats and scrapes etc give a good indication of the relative use by tiger of the study area. Since the parameter of interest is of animal occurrence, all signs (tracks and pellets) would be recorded. The beginning and end points of the raus would be marked using a GPS for future monitoring. For the analysis, transect "segments" would comprise the basic sampling unit. Each segment would be of 250m in length. Pugmark encounter rate will be measured as the total number of pugmark encounters upon the total number of segments. The exercise would be carried out with a team of 2-4 persons and on an average take 3-4 hours per transect (1.25-1.5 km/hr). Since the parameter of interest is the relative occurrence in the area, and not abundance, pugmarks of tigers and leopards, whenever seen would be identified and the continuity of the pugmark trails was used to identify them as separate encounters. Care will also be taken to avoid double counts of trails. Tracks of ungulates would be recorded in each segment as low (<5 track trails), common (>5 track trails) and abundant (>10 track trails). Pellet groups of prey species and cattle and elephant dung depositions would also recorded.

Estimation of prey density in Rajaji National Park

Densities of the wild prey would be estimated using line transects in conjunction with distance sampling (Anderson et al. 1979). A total of 24 line transects have been laid (Harihar A., Pandav B. and Goyal S. P. Unpublished data, WII), with lengths varying from 0.91km to 2.5km in different parts of the study area covering all vegetation types across the park, amounting to a total length of 33.5km. A total of three repeat samples (temporal replicates) per season would be carried out. Line transect data would be collected between 0615 hrs and 0930 hrs by two observers. On every walk species, group size, age-sex composition, sighting angle measured using a hand held compass (KB 20, Suunto, Vantaa, Finland) and sighting distance measured by a laser range finder (Yardage Pro 400, Bushnell, Overland Park, Kansas USA) would be recorded. Population density of principal prey species would be estimated using program DISTANCE 4.1 Release 2 (Thomas et al. 2004). In order to model detection functions so as to estimate species density, the data for each species per season would be examined for signs of evasive movement and peaking at great distance from the line of walk. Following this, suitable modifications would be made so as to ensure a reliable fit of key functions and adjustment terms to the data in order to arrive at density estimates. Akaike Information Criterion (AIC) and goodness-of-fit (GOF-p) tests would be used to judge the fit of the model. Using the selected model, estimates of group density (D_g), group size (GS) and individual density (D_i) will be derived.

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Estimation of tiger density in Rajaji National Park

In order to estimate the population density of adult tigers in the study area we would use photographic capture-recapture analysis (Karanth 1995, Karanth and Nichols 1998). Thirty camera-trapping stations were identified during 2004 in the Chilla range of RNP (Harihar 2005) and an additional 10 were included in October 2006 (Harihar A., Pandav B. and Goyal S. P. Unpublished data, WII). While an additional twenty camera-trapping stations were identified in the ranges of Dholkhand east and Dholkhand west within the study area during a reconnaissance carried out during December 2006 (Harihar A., Pandav B. and Goyal S. P. Unpublished data, WII). These trapping stations were selected so as to maximise the capture probabilities of tigers (Karanth 1995). In order to systematically sample the area, sampling blocks (spatially separated) were identified within the intensive study area and the cameras were deployed in a phased manner. Each block would consist of 10 trap sites run for 15 consecutive days/occasions. Thus, each sampling occasion would combine captures from 1 day drawn from each block. One trap-night would be a 14-hour period (1700-0700 hrs) during which a camera would remain functional. Owing to a good network of roads all the 10 trapping sites in a block can checked on a daily basis. Every tiger captured would given a unique identification number (e.g., RT-002) after examining the stripe pattern on the flanks, limbs and forequarters. Following the identification of tigers, capture histories (*X* matrix) would be developed and analysed using program CAPTURE (Rexstad and Burnham 1991). The density (*D*) of tigers in the study area would then be estimated as the population size (*N*) divided by the effective sampled area (*A(W)*), where *A(W)* would be estimated by creating a polygon over the trapping stations (*A*) and a buffer width (*W*) estimated as half the mean maximum distance moved (½ MMDM) by recaptured tigers added to the camera trap polygon (*A*).

Assess the food habits of tigers and leopards

Scat samples would be collected from roads, trails and paths opportunistically. The distinction between leopard and tiger scats would be made from the size of scats and signs (pug marks and scrapes) present in the area. During the collection of scats from the field, the GPS locations would also be noted. The samples would then be sun dried in the field, individually labelled and brought to the laboratory for further analysis. The contents of the scats would be sieved and prey remains such as bones, hooves, teeth and hairs separated. By using features such as medullary and cuticular structure from the hair in the scats, individual species would be identified by comparing it to reference samples from the Wildlife Institute of India. The frequency of occurrence (F%; per cent of a particular species in the total number of prey items found) would be calculated, since F% is known to be misleading (Ackerman et al. 1984) the relative biomass (D%) and numbers (E%) of individual prey species killed by tigers and leopards using scats would be computed using the Akcerman regression equation (Ackerman et al. 1984) developed for puma (*Puma concolor*). The extent of trophic niche overlap

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would be measured using Pianka's index (Pianka 1973). Prey selectivity and annual wild prey off take would be calculated based on availability of the prey species derived from density estimates using line transects. To estimate the expected proportions of prey in the diets of these predators under non-selective predation of wild prey species, prey species densities (D_i; individual density) derived through line transect sampling would be used. Under the null hypothesis that the prey killed is in proportion to availability, a comparison between the observed proportions in scats to the expected proportions will be carried out by constructing 95% Bonferronis' simultaneous confidence interval. Further to assess predator selectivity for prey across size classes, we would first categorised wild prey species as either being small bodied (peafowl and common langur, <20 kg), medium (chital and wild pig, 20-50 kg) or large (sambar and nilgai, above 50 kg). And then compare the proportion of these categories consumed by predators in proportion to their availability and using a selectivity indix (Chesson 1978).

Table 1. Summary of objectives, field methods and analytical methods.

Objective	Field methods	Analytical methods
Occupancy rates of principal prey species	Repeat sampling for pellet encounters along systematic transects within 2km x 2km grids	Occupancy estimation; PRESENCE 2 (Hines 2006) and Ecological Niche Factor Analysis; Biomapper 4.0 beta (Hirzel et al. 2002)
Occurrence patterns of tigers and leopards	Sign encounter surveys along stream beds	Hierarchical cluster analysis; (SPSS, Chicago, IL, USA)
Prey densities	Line transects (12 spatial replicates)	Distance analysis; Distance 4.1 Release 2 (Thomas et al. 2004)
Density of tigers	Camera trapping (40 trap sites)	Photographic capture recapture; CAPTURE (Rexstad and Burnham 1991)
Food habits of tigers and leopards	Collect scats opportunistically	Percent occurrence and Biomass off take of prey species; (Ackerman et al. 1984)

A need for an additional grant

As seasons seem to have a marked influence on the prey and predator populations with respect to distribution and abundance we propose that during this period (October 2007; Post Monsoon, January 2008; Winter, April 2008; Summer and July 2008; Monsoon) the distribution of prey will be estimated using a hierarchical sampling design to estimate the occupancy rates, while sign surveys to determine the occurrence patterns of tigers and leopards will be carried out. The prey and predator densities will be computed for the study area based on the protocol established (Harihar, A., Pandav, B. and Goyal, S. P. Unpublished data, WII). The 12 delineated line transects will be sampled three times each and phase wise (2 phases) camera trapping will be carried out in the 40

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lected trapping locations for 15 days each per season during the sampling period. Scat samples will lso be collected to assess food habits. Data collected during this period would enable us to design onitoring protocols for prey and predators in RNP for long term monitoring.

Table 2. Proposed plan of work

	Objective	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
Field sampling	Occupancy rates of principal prey species	▨	▨		▨	▨		▨	▨		▨	▨	
	Occurrence patterns of tigers and leopards	▨	▨	▨	▨	▨	▨	▨	▨		▨	▨	
	Prey densities across RNP	▨	▨		▨	▨		▨	▨		▨	▨	
	Density of tigers across RNP	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
	Food habits of tigers and leopards	▨	▨	▨	▨	▨	▨	▨	▨	▨			▨
Analysis and Report writing													

Grant needed

Therefore, we visualise a need for a grant of Rs. 6,00,000 (Six Lakh Rupees) to meet the expenditures during collection of data (October 2007 – September 2008). The previous study supported by the Save the Tiger Fund (Grant 2005-0013-027; Total amount 30974$) and WWF-International aided in assessing the status of prey and predator populations across four seasons (post monsoon; October 2006, winter; January 2007, summer; April 2007 and monsoon; July 2007).

S No	Heads	Proposed Grant Amount INR	Proposed Grant Amount US$	Proposed Grant Amount CHF
1	Fellowship to JRF	1,44,000	3600	4364
2	Wages for field assistants	1,08,000	2700	3273
3	Vehicle hire	1,80,000	4500	5455
4	POL and Maintenance	50,000	1250	1515
5	Miscellaneous	1,18,000	2950	3576
	Total	**6,00,000**	**15000**	**18182**

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Expected outputs of the project

As a result of this proposed project a report detailing the spatio-temporal patterns of occupancy would be prepared. As effective conservation is possible only with reliable quantitative information, we feel that the results of this study would aid in our understanding of seasonal patterns of abundance and occurrence of tigers and wild prey in RNP.

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Project- "Response of tiger population to habitat, wild ungulate prey and human disturbance in 'Rajaji National Park, Uttaranchal"

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Tuesday, 06 January 2009

CONTRACT P9S0747.01 - 007

TIGER ACTION PLAN COORDINATION - GRANT TO WILDLIFE INSTITUTE OF INDIA

Dear Mr Goyal,

We are pleased to inform you that WWF-World Wide Fund For Nature (formerly World Wildlife Fund) ("WWF International") has approved grant funding of **CHF 19,975.-** to Wildlife Institute of India for the period 01/01/2009 to 31/12/2009.

The funds have been provided to WWF International by WWF Netherlands.

The term and conditions attached to these funds are as follows:

1. THE ACTIVITY AND BUDGET

Wildlife Institute of India agrees to carry out the activities set out in the Terms of Reference in Attachment 1 ("the Activity") in accordance with the Project Budget set out in Attachment 2. Both attachments form part of this Agreement.

2. RELATIONSHIP OF PARTIES

2.1. For the purpose of this Agreement, Wildlife Institute of India is deemed to be an independent contractor according to article 394 ff of the Swiss code of obligations and nothing in this Agreement creates an employee-employer relationship, partnership, joint venture, or agency contract of any kind with WWF International.

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President: HE Chief Emeka Anyaoku
Director General: James P. Leape
President Emeritus:
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WWF-Fondo Mundial para la Naturaleza
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Also known as World Wildlife Fund

World Wildlife Fund (WWF)

Final Financial Reporting Form

Project name and number : Response of tiger population to habitat, wild ungulate prey and human disturbance in Rajaji National Park, Uttarakhand, India: Assessing the spatio-temporal variations in occupancy. (Contract 9S0747.01-003)

Period of Performance *(from Grant Agreement)* : January to December 2008

Total Project Budget

S. No.	Head	Approved Budget (CHF) *(from Grant Agreement)*	Actual Expenditure (CHF)
1	Fellowship (Research Fellow)	4364	4606.06
2	Wages for Field assistants (Two)	3273	3273.00
3	Vehicle Hire	5455	4364.00
4	POL & Maintenance	1515	2134.00
5	Miscellaneous	3576	3806.00
	Total	**18183**	**18183.06**

I, hereby, certify that all expenditures described above are based on the information provided by the finance department and are accurate and complete.

Wildlife Institute of India

Date : 24th December, 2008

Approved: SPGoyal

Name : (Dr. S.P. Goyal)

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Thursday, 03 January 2008

CONTRACT 9S0747.01 - 003

TIGER ACTION PLAN COORDINATION - GRANT TO WILDLIFE INSTITUTE OF INDIA

Dear Mr Goyal,

We are pleased to inform you that WWF-World Wide Fund For Nature (formerly World Wildlife Fund) ("WWF International") has approved grant funding of **CHF 18,182.-** to Wildlife Institute of India for the period 01/01/2008 to 31/12/2008.

The funds have been provided to WWF International by WWF Netherlands.

The term and conditions attached to these funds are as follows:

1. THE ACTIVITY AND BUDGET

Wildlife Institute of India agrees to carry out the activities set out in the Terms of Reference in Attachment 1 ("the Activity") in accordance with the Project Budget set out in Attachment 2. Both attachments form part of this Agreement.

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1.1. Project Description.

Project Abstract:	Conduct an intensive, replicated camera-trapping survey of tigers in Rajaji NP. Interpret data in light of tiger diet, wild ungulate density, vegetation type and levels of human disturbance. Two post-graduate students will be trained.

Project Phase 1:	1) Camera Trapping survey in 15 stations in four 50km^2 blocks 2) Scat collection and presence/ absence survey across the Chilla sanctuary. 3) Estimate densities of wild ungulates using line transects 4) Estimate level of human disturbance and relate this to tiger and prey density.	**Budget Category**	**NFWF Funds**
		Salaries:	$10,528
		Equipment:	0
		Other:	$14,256
Matching Contributions allocated to Phase 1:	$0	**TOTAL**	$24,784

Project Phase 2:	Produce satisfactory final financial and programmatic reports and provide NFWF with 5-10 digital photographs in jpeg format, 300dpi resolution to illustrate different aspects of the project.	**Budget Category**	**NFWF Funds**
		Salaries:	$2,632
		Equipment:	0
		Other:	$3,564
Matching Contributions allocated to Phase 2:	$0	**TOTAL**	$6,196
		NFWF PROJECT TOTAL	$30,980

1.2. Project Deliverables.

1. To estimate the population of tiger in the study area.
2. To study food habits, habitat occupancy and frequency of use by the tiger.
3. To estimate the ecological density of the wild ungulate prey species.
4. To determine the level of human disturbance and its relationship with prey abundance, food habits and frequency of use by tiger.

1.3. Diligence and Communication Required. The NFWF Recipient agrees to pursue completion of the Project diligently and to communicate with the Project Manager on a regular basis with respect to the status of the Project, including but not limited to providing the reports discussed in Section 4 below. Failure to diligently pursue completion of the Project within the Project Period and/or failure to so communicate with the Project Manager will be deemed a material default in this Agreement, entitling NFWF to terminate this Agreement.

Section 2. RESTRICTION ON FUNDS

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[illegible]

National Fish and Wildlife Foundation
Final Financial Reporting Form
**Fill in all shaded areas*

Project Name and Number: Tiger Responses to Prey and Human Disturbance #2005-0013-027

Period of Performance *(from Grant Agreement)*: **11/30/2005** to **08/31/2007**

Note: All project expenditures, including match, must take place between the project start and end dates designated in the Grant Agreement.

Budget for Phase #1:

Category	Approved Budget NFWF Funds *(from Grant Agreement)*	Actual Expenses NFWF Funds
Salaries & Benefits	$10,528	**$ 11,154**
Equipment**	$0	**$ 0**
Other	$14,256	**$ 15,721**
Total	$24,784	**$ 26,874**

Matching Contributions Required for Phase #1: $___0___ *(from Grant Agreement)*
Matching Contributions Expended for Phase #1: $___0___

Budget for Phase #2:

Category	Approved Budget NFWF Funds *(from Grant Agreement)*	Actual Expenses NFWF Funds
Salaries & Benefits	$2,632	**$ 1,398**
Equipment**	$0	**$ 0**
Other	$3,564	**$ 2,708**
Total	$6,196	**$ 4,106**

Matching Contributions Required for Phase #2: $___0___ *(from Grant Agreement)*
Matching Contributions Expended for Phase #2: $___0___

Total Project Budget:

Category	Approved Budget NFWF Funds *(from Grant Agreement)*	Actual Expenses NFWF Funds
Salaries & Benefits	$13,160	**$ 12,551**
Equipment**	$0	**$ 0**
Other	$17,820	**$ 18,429**
Total	$30,980	**$ 30,980**

**Equipment only includes tangible nonexpendable personal property having a useful life of more than one year and an acquisition cost of $5,000 or more per unit.

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World Wildlife Fund (WWF)
Final Financial Reporting Form

Project Name: Response of tiger population to habitat, wild ungulate prey and human disturbance in Rajaji National Park, Uttarakhand

Period of Performance: 1st July to 30th September 2007
(from Grant Agreement)

Total Project Budget:

Category	**Approved Budget WWF Funds** *(from Grant Agreement)*	**Actual Expenses WWF Funds**
Fellowship	$987.65	$1,025.64
Wages	$666.67	$634.64
Vehicle hiring	$740.74	$750.25
POL and Maintainance	$493.83	$683
Film rolls and developing	$864.20	$627
Miscellaneous	$444.44	$477
Total	**$4,197.53**	**$4,197.53**

I hereby certify that all expenditures described above are complete and that the above information is accurate and complete.

Wildlife Institute of India

Approved: ______________ Date: 27th Dec., 2007
Signature

Dr. S.P. Goyal
Print name and title

E-mail: goyalsp@wii.gov.in

Telephone: 91-135-2640112

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Save the Tiger Fund Grant Application

Applicant Information

Organization (Grantee): Wildlife Institute Of India

Contact Name: Dr. Bivash Pandav and Dr. S.P. Goyal

Contact Title: Faculty of Wildlife Sciences

Address: Wildlife Institute of India, Post Box # 18, Chandrabani.

City, State, Zip and Country: Dehradun – 248 001, Uttaranchal, (North) India

Phone: 91 135 2640112-115 Fax: 91 135 2640117 Email: pandavb@wii.gov.in

Grant Request

Save The Tiger Fund:	$ 30980
Total Grant Amount:	**$ 39180**

Project Information

Project Name: Responses of tiger (*Panthera tigris*) population to habitat, wild ungulate prey and human disturbance in Rajaji National Park, Uttaranchal, Northern India

Start Date: November 2005 End Date: October 2006

City: Dehradun

State / Province: Uttaranchal

Country: India

TCU (Tiger Conservation Unit): I

Project Type

[√] Field Study and Management

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Budget:

	Save The Tiger Fund Request	Other Sources *	Total Project Amount
Salaries: **I. Post Graduate course fees for two students @ US$5,500 per student** **II. Fellowship for one research fellow @ US$180 per month for 12 months**	US$11,000 US$2,160	-	US$11,160
Contractual Services: **Wages of 2 field assistants @ US$55 per month for 12 months**	US$1,320		US$1,320
Benefits:			
Supplies:			
Travel:	US$3,000		US$3,000
Equipment:	US$9,000**	US$6,700***	US$15,700
Equipment Rental:			
Materials: **Purchase of films, processing and printing charges**	US$2,500		US$2,500
Printing/Publications:	US$2000		US$2,000
Other (you must specify):	-	US$1,500****	US$1,500
Total:	**US$30,980**	**US$8,200**	**US$39,180**

* **From the Wildlife Institute of India (WII)**

** **Purchase of 10 Trailmaster sets, 20 cameras and 10 multiple trigger devices @ US$900 per set**

*** **Equipment such as 5 Trailmaster sets, 10 cameras and 5 multiple trigger devices, GPS, Hip chain, Laser range finder, Compass, Binocular will be provided by WII**

**** **The base camp cost will be borne by the WII**

Signature

Signature of Executive Director or Project Office:

Name of Executive Director or Project Office: Shri. P. R. Sinha

Proposal Submission Date: 4 June 2004

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Project Narrative

I. Title: Responses of tiger (*Panthera tigris*) population to habitat, wild ungulate
prey and human disturbance in Rajaji National Park, Uttaranchal,
Northern India

Summary

The proposed project intends to study the responses of tiger (*Panthera tigris*) population in relation to habitat, ecological density of wild ungulate prey species and human disturbance. Information obtained will enable us to identify and quantify a threshold level, beyond which the survival of the tiger may prove detrimental.

II. Project abstract

The Rajaji National Park (RNP) and the adjoining Corbett Tiger Reserve forms an important Tiger Conservation Unit in South Asia (TCU I). Like most protected areas in India, RNP is under severe anthropogenic pressure. Of late, the management has undertaken the relocation of human settlements from parts of RNP. In the first phase of this programme ca. 150 sq. km area had been made completely free of human settlements. This has led to a remarkable recovery of habitat as well as the predator and prey population. However, this is yet to be quantitatively assessed and scientifically documented. Such documentation will build a strong case for future relocation programs. The proposed project aims to look at the tiger (*Panthera tigris*) population in this area (ca.200 sq. km) and study their response to recovery of the habitat and its prey species under varied level of disturbance. It is proposed to estimate the population of tiger on the eastern bank of River Ganges (Chilla and Gohri ranges of RNP) using camera traps. Food habits of tigers will be determined by scat analysis. The entire study area will be divided into grids (2 X 2 km) and habitat occupancy, frequency of use by tiger will be determined using indirect evidences recorded on transects in randomly selected 30 per cent grids. Ecological densities of wild ungulate prey species will be estimated on identified transect using the program DISTANCE. Varied level of human disturbance will also be quantified to establish the relationship with the level of use by tiger. Data generated from the proposed study will enable us to identify and quantify a threshold level, beyond which the survival of the tiger may prove detrimental.

III. Project Description

A. Project Need

Viable populations of tigers require large tracks of natural areas. Over the last century, the tiger's landscape has changed dramatically, with the main factor being habitat shrinkage due to fragmentation (Smith *et al*., 1998). An expanding human population has increased pressure on the tiger's habitat, its prey and on the tiger itself (Seidensticker *et al*., 1999). Vast tracts of forested landscape that once housed the tiger have now been lost to human habitation. This has caused a sharp decline in the ungulate

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populations and the numbers of tigers too. Recent studies (Karanth and Nichols 1998, Carbone and Gittleman 2002, Karanth *et al*., 2004) suggest that abundance of tigers is directly related to densities of ungulate prey species. The effect of human presence on habitat and its use by wild ungulate species are different, and this consequently affects the utilization of these regions by the tiger. Though increased awareness of the subject has launched several conservation efforts there still exists no hard statistics concerning the tiger's status compiled in any central database. Reliable indices of the trend in tiger numbers, availability of habitat as well as prey, or even assessment of the risk faced in the various sectors of its range are still lacking.

Possibly the most well recognized felid in the world, the tiger was declared endangered when their number dropped from an estimated 40,000 individuals at the turn of the 20th century to about 1800 individuals in 1972 (Panwar 1987). Project Tiger, one of the biggest conservation initiatives in the world, was thus initiated to save India's declining population of tigers and their habitats. It was envisioned that protecting the tiger and therefore its habitat would help in the conservation of all species that live alongside the tiger. It was stated in the objectives in the plan outline of project tiger, that the creation of the reserves should not be regarded as a cause to sterilize the area as far as human use is concerned. The plan outline envisioned the use of the areas for recreation and education alongside the phasing out of other forms of human use such as grazing, timber, Non Timber Forest Produce (NTFP) and firewood extraction (Govt. of India 1993). However, in the human dominated Indian landscape there are no easy solutions to this problem. Most reserves of the country are faced with severe anthropogenic pressures from both around and within them (Kothari *et al.,* 1996). Increasing human – wildlife conflicts, also further complicates the issue. Village relocation and rehabilitation programs have been initiated in many of the protected areas especially from within the core of tiger reserves. They have however been the source of the people Vs wildlife debate. But the fact that we are losing out on time for the conservation of this species urges us to prioritize our conservation efforts. However this has been effective in many areas and the comeback of wildlife has been promising, one of the most quoted examples being the relocation of villages from Kanha that is now the last home of the hard ground Barasingha, *Cervus duvauceli branderi*.

Rajaji National Park (RNP) which forms the north western limit of the tiger distribution in India, along with the adjoining Corbett Tiger Reserve forms one of the largest contiguous patches of tiger habitat in north India (Johnsingh and Negi 2003) and is part of TCU I (Wikramanayake *et al*. 1999). Most parts of RNP are under severe anthropogenic pressure. Relocation of human (Gujjar community) settlements is underway, following the notification of the earlier Rajaji Wildlife sanctuary to a National park. As a pilot programme, 74 gujjar settlements have been shifted out of ca. 150 sq km form the Chilla range along the eastern part of RNP. Presently void of human settlements, this area shows very healthy resurgence of vegetation indicating promising signs of recovery with respect to utilization of the area by wildlife. The use of the area by tigers and its prey species has dramatically improved necessitating a quantitative study to assert the importance of the area for conservation. Taking into account the improving

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status of the protected area and the relieving pressure from human habitation within this range of the RNP a study is proposed with the following objectives.

B. Objectives

The objectives of the study are:

1. To estimate the population of tiger in the study area.
2. To study food habits, habitat occupancy and frequency of use by the tiger.
3. To estimate the ecological density of the wild ungulate prey species.
4. To determine the level of human disturbance and its relationship with prey abundance, food habits and frequency of use by tiger.

Study area

The RNP is divided by the Ganges into an eastern half comprising of Chilla (148 sq. km) and Gohri range (70 sq. km) (Fig. 1) and Rajaji and Motichur wildlife sanctuaries on the western half. The proposed intensive study area lies south of Siwalik ridge covering the sanctuary of Chilla (29°54’ N to 30°15’ N and 77°50’ E to 78°16’ E). Both these parts of the RNP are connected by the narrow Chilla – Motichur corridor (Johnsingh *et al.*, 1990). The corridor maintains the contiguity with the Corbett Tiger reserve thus making this Rajaji Corbett Tiger Conservation Unit (RCTCU) (Johnsingh and Negi 2003). The RCTCU is one among the eleven Level-1 Tiger conservation units identified in the Indian subcontinent for the long-term conservation of the tiger (Wikramanayake *et al.* 1999). The RCTCU and its surrounding areas fall in the Siwalik range. The Siwaliks run parallel to the outer Himalayas from Jammu to Assam and is considered one of the most threatened and fragile ecosystems in the Indian subcontinent. The study area is characterized by high undulating topography consisting of hills intersected by dry riverbeds called ‘raus’. The forests of this region are categorized into Northern Indian Moist Deciduous Forest and Northern Tropical Dry Deciduous Forest (Champion and Seth 1968). Apart from these several plantations of *Eucalyptus* species are found. The vegetation of this region is a result of various physical and climatic factors including anthropogenic pressures such as human habitation, extensive grazing, lopping and cutting of trees for firewood and fodder (Edgaonkar 1995).

Over the years, growing human population and its demand for more forestland for agriculture and various developmental projects have broken the continuity of the previously large forest patch. The presence of the large town of Haridwar has been a tremendous pressure to the forests. The study site was under the heavy influence of Gujjar communities, who used to feed their livestock, largely buffaloes (*Bubalus bubalis*) by lopping trees and grazing them in the forest. The intensive lopping, firewood extraction and grazing had led to lack of sustainable regeneration and proliferation of weeds (Edgaonkar, 1995), thus aggravating the condition of this fragile and one of the finest habitats of this country for the survival of the tigers.

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C. Methodology

1. To estimate the population of tiger in the study area.

The intensive study area of ca. 200 km^2 will be divided into four trapping blocks of ca. 50 km^2 each. A total of 15 trapping stations (with double cameras) would be established in each block. The blocks will be sampled for 20 consecutive days (Karanth *et al.*, 2004, Wegge *et al.*, 2004). Besides active animal trails, traps will also be placed at strategic locations with an average spacing of 3-4 km^2. Care will be taken not leave a sufficiently large hole without camera traps where a tiger might have a zero capture probability (Karanth and Nichols, 1998, Kawanishi, 2002). Though the trapping locations will remain stationary we will have the flexibility of shifting cameras depending on local movement of tigers in the area. Owing to a good network of roads in the study area we will be in a position to check the 15 trapping stations on a daily basis.

Photographic captures of tigers would be used to identify individuals and build capture histories. Only photographs in which individuals can be clearly identified will be used for analysis. The capture-recapture method (Otis *et al.*, 1978, Karanth, 1995; Karanth and Nichols, 1998) would be used to estimate the population. The closed population model has been widely used in tiger population studies and considered reliable (Karanth and Nichols, 1998, Kawanishi, 2002).

2. To study food habits, habitat occupancy and frequency of use by the tiger

For studying food habits, scats will be collected from the study area. For each scat collected, date, time, location (GPS), and season of collection would be noted. The scat samples would then be washed and any remains of bones, teeth or undigested body parts of prey would be separated. It would then be brought back to the laboratory for determining prey selection through identification of hair sample (Mukherjee *et al.*, 1994, Karanth and Sunquist 1995) and biomass of prey consumed will be estimated using correction factor of Ackerman *et al.* (1984).

In order to assess the habitat occupancy of tiger across the study area, the Chilla sanctuary (ca. 200 sq. km) will be divided into of 2 X 2 km grids that will be overlaid in a GIS (Geographical Information System) program. Topographic maps (1:50,000) of the Survey of India (SOI) would be used as an input layer in the GIS/ARCINFO for grid overlaying. Presence/absence data have been widely used in determining habitat occupancy and monitoring programs (Dzieciolowski, 1976; Kie, 1988). However, chances are there that a species may go undetected even if it is present in the area. In such cases estimation of detection probability using presence/absence data has been advocated for better inferences (MacKenzie *et al.*, 2002). Tiger pugmark and other signs such as scrapes, claw marks would be noted along with GPS location on randomly selected transects for each grid. Multiple sampling on these transects will be carried out for estimating the detection probability (MacKenzie *et al.*, 2002, 2003). This would lead us to determine the differential level of use by tiger within the study area. With the use of Remote sensing data and the Geographical Information System a predictive model of

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tiger habitat can be built so as to help identify areas within the protected zone that would need conservation focus.

3. To estimate the ecological density of the wild ungulate prey species.

Ecological densities of wild ungulate species will be estimated using conventional line transect method (Anderson *et al.*, 1979, Burnham *et al.*, 1980; Buckland *et al.*, 1993; Laake *et al.*, 1994). Line transects have been found very effective and reliable in estimating densities of animals (Karanth and Sunquist 1992, 1995; Khan *et al.*, 1996; Karanth and Nichols 1998). The strength of this method lies in the fact that it accounts for non randomness of animal distribution by incorporating the probability of detection g(x). Line transects will be laid in the flat (2 to 3 km) and hilly (1 to 2 km) terrains in the four sampling blocks of the study area. A previous study in RNP on ungulates has revealed that the minimum coefficient of variations on density estimates of ungulates can be achieved by having eight and 14 transects in plains and hills respectively (Singh *et al.*, 2004). Upon sighting an animal on the transect, data on group size, sighting distance, and sighting angle will be recorded. Sighting distance and angle will be measured with the help of a Laser range finder and a compass respectively. Density of each ungulate species will be estimated using the program DISTANCE (Laake *et al.*, 1994).

4. To determine the level of disturbance and its relationship with prey abundance, food habits and frequency use of tiger.

The girded intensive study area of ca. 200 sq. km will be qualitatively assessed for disturbance. This will be carried out by ocular estimations of vegetation cover, presence of weeds, livestock dung, signs of lopping and firewood collection on randomly selected 20 points in each grid. Each point will be assigned on a scale of 0 to 5 (0 - no to 5 – high). The quantitative assessment of the disturbance will also be done in the randomly identified grids. On identified transects, circular plots of radius 10m will be laid at every 200m for mean canopy cover and trees (species and number of individuals), extent of lopping and firewood collection signs. A nested circular plot of radius 5m will be laid for shrubs species and numbers and percent cover and a plot of 1m radius within this will be examined for grass percent cover and dominant species. A belt transect of 100m X 2m will be laid at each sampling point for dung (wild and domestic) count as an indirect evidence of use. The data collected will be analyzed through multivariate statistics using SPSS to identify the indicators of disturbance.

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Plan of work

Month/Activity	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Field data collection	▨	▨	▨	▨	▨	▨						
Data analysis and writing of dissertations							▨	▨	▨			
Report submission and Preparation of manuscripts for publication										▨	▨	▨

The project will form the dissertation of two postgraduate students in Wildlife Science (Abishek Harihar and Amit John Kurien) of Wildlife Institute of India (WII). Drs. S. P. Goyal and Bivash Pandav, Faculty of Wildlife Sciences of WII will supervise both the students.

D. Management Implications

Following the notification of Rajaji National Park, the Forest Department has relocated 74 human settlements from the Chilla range. The proposed study will encompass this relocated site as well as the adjoining area where human disturbance is still prevalent. Through this study we intend to document the recovery of tiger and its prey population in the study site as well as investigate the impact of disturbance on both tiger and its prey in the surrounding area. This study will help in identifying critical tiger habitats across the RCTCU, which would aid Forest Department and other Non Government Organizations (NGO) for the cause of conservation. Besides, this study intends to demonstrate the success of the relocation programme, which would serve as a model for managers of other protected areas in the country.

E. Evaluation

This study will result in dissertations of two postgraduate students of WII. The success of the study will be evaluated by the quality of their dissertations and resulting publications in peer reviewed journals.

F. Results

There lies an imperative need to understand responses of varied levels of disturbance in relation to frequency of tiger use, changes in food habits and prey availability. The study expects to identify and quantify a threshold level, beyond which the survival of the tiger may prove detrimental.

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IV. Why the Foundation Should Use Save the Tiger Fund monies for this Project?

The work is proposed to be carried out in Rajaji National Park (RNP), which forms the northwestern most population of tiger in India. RNP and the neighboring Corbett national park are considered the highest conservation status as Tiger Conservation Unit I (TCU I, Wikramanayake *et al.* 1999). Although RNP is identified as a region of high priority for conservation, a detailed study on tiger from this area is still lacking. The proposed project intends to determine and ascertain the factors responsible for level of use by tiger and its prey species in relation to habitat categories and magnitude of disturbance in TCU I characterized by Northern Indian Moist Deciduous Forest and Northern Tropical Dry Deciduous Forest of "Siwalik" ecosystem. The outcome of the study can be used to identify critical areas across Rajaji Corbett Tiger Conservation Unit (RCTCU) for better management of the species.

After relocation of gujjars, the Chilla Range of Rajaji NP is showing remarkable signs of recovery. We strongly believe that the tiger population in this area will bounce back soon. Initiation of this study will help in generating good base line information on the tigers using the east bank of Ganges. This will be invaluable for future monitoring of tiger population in this area.

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